Construct the Cyclops Dip Meter

W4ATE's unique single-coil design captured an Honorable Mention in 73's Home-Brew II Contest. Now you can build this award-winning circuit for yourself.

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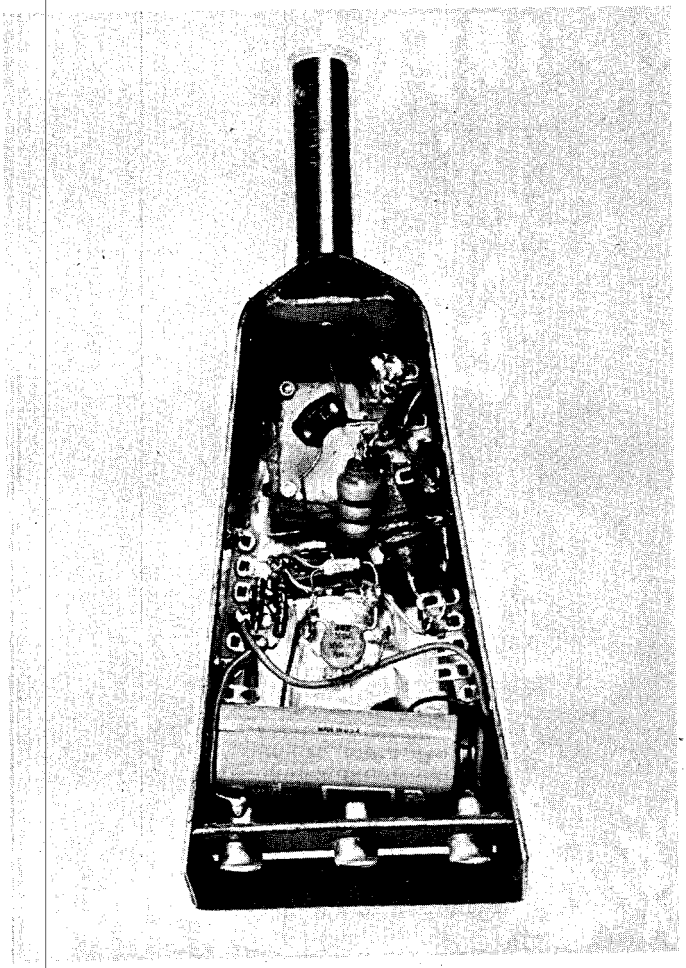


Component layout.

The dip meter is clearly one of the most versatile tools for anyone involved with antenna systems or rf-related equipment. Its myriad uses range from troubleshooting tuned rf circuits to locating power lines concealed inside a building wall.

The most evident shortcoming of present-day dippers is the inconvenience of constantly changing and storing a half-dozen plug-in coils. Especially frustrating is the experience of attempting to pinpoint the frequency of a resonant circuit which falls at either end of the dial range. When another coil is plugged in, the meter current requires readjustment, and one often wonders whether the new dip obtained is the same one as read with the previous coil.

Dip-Meter History

These problems have been endured for years and have been attacked from many directions. One commercial design utilized a coil of flexible wire which was reeled from one nonconducting coil form onto a metal shorting form as the dip meter was tuned through its continuous range. The product was cosmetically attractive, but not entirely practical, and appeared only briefly on the market.

I at one time built a prototype dip meter with all coils

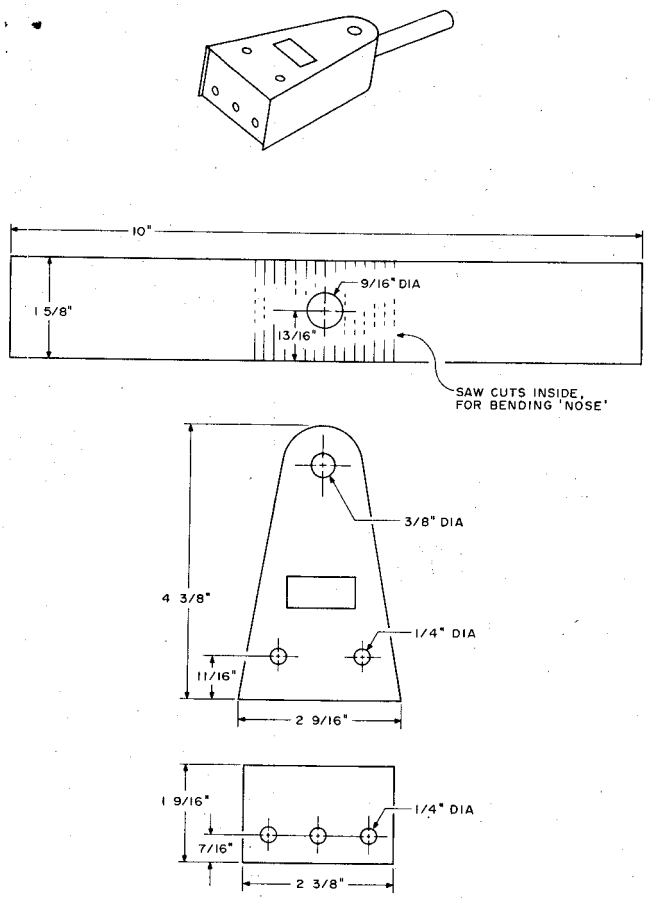


Fig. 1. Meter-case construction for the one-coil dip meter. Material is glass epoxy double-clad PC board.

Completed meter.

mounted on a turret and enclosed within a non-shielding case. The unit performed well, but was too bulky to reach tuned circuits located within high-density packages. Other wide tuning range tanks are possible, but may involve mechanical complexes which simultaneously tune a variable capacitor and move a ferrous coil slug. In the dip-meter application, the proximity of the slug would disturb the tuning of the measured tank; also, the arrangement becomes too large.

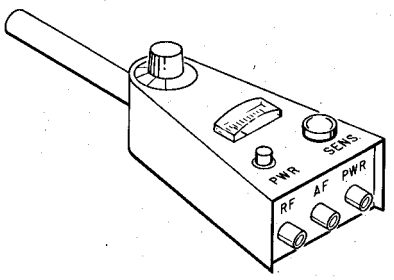
The Single-Coil Concept

Most "new" devices are the happy result of divorcing and remarrying existing arts into combinations not previously joined. So, a wide-range tank used in a previous design[1] was recalled and set up in prototype for study. The type of variable capacitor which utilizes plastic sheets between the plates provides maximum capacity per cubic centimeter. However, in this application, rf heating of the dielectric occurs, resulting in unacceptable frequency drift. Suitable compact air-dielectric units are listed in the parts data.

To provide the widest tuning range, a capacitor with the highest maximum-to-minimum tuning capacity ratio is required. For this reason, select one with the widest gap when adjusted to the wide-open plate setting. All parallel padders must be removed completely. To further ensure the widest tuning range, the lightest loading of the tank by the active device is necessary, which also points to the use of an FET. Reduction of loading by tapping down on the coil usually introduces false dips; therefore, a low-value gate coupling capacitor is used instead. The inductance of the coil between the source tap and ground resonates well above the design coverage and therefore causes no erroneous indications. The coil is shaped with a high length-to-diameter ratio to allow probing components located in close quarters.

The Circuit

The wide-range tank was joined to the vigorous Hartley oscillator in a simple one-



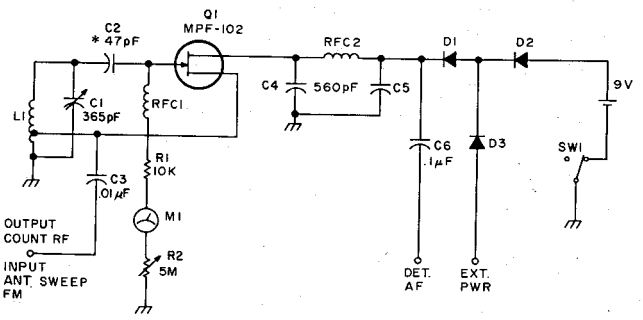
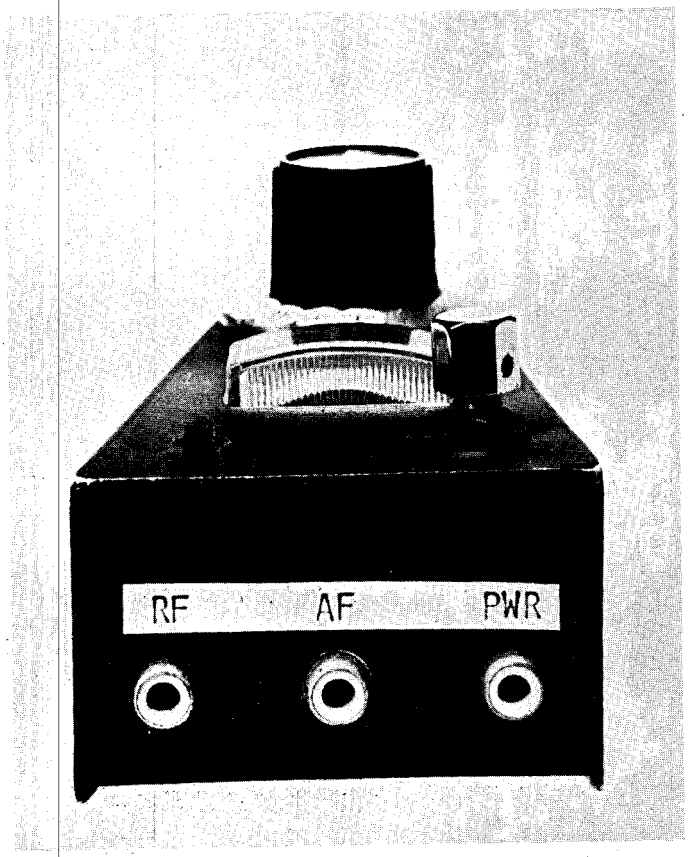


*Fig. 2. Circuit schematic and details of control mounting. *Polystyrene or silver mica. See Parts List.*



End view.

ring ceremony. The most critical items for minimizing minor spurious dips are the two rf chokes. The small 3-pi winding type has been found to be a good choice. Chokes with metallic cores are not recommended. To a minor degree, the gate resistor may cause ripples. Values between 3 and 10k Ohms are suitable. The gate-current potentiometer value of 5 megohms was chosen so that conditions of regeneration or near-oscillation may be easily controlled for use in the detector mode.

Construction

The case used for the one-coil dip meter is not critical. The LMB type 425 or Econobox type CU-124 enclosures are suitable and will permit a larger dial. The case I used was formed of glass epoxy printed circuit board with the copper stripped from the outside surfaces while applying heat. Copper is also removed from inside the "nose" area, which is also sawed halfway through for forming the curved portion. The forming should be done outdoors to avoid breathing fumes generated by heating the material. Apply heat from a propane torch and bend the curved portion around a suitable piece of pipe. The heated board should be held in the desired shape by a C-clamp and allowed to cool for 5 minutes.

The meter and tuning capacitor are epoxied in place for simplicity and to avoid screw heads showing on the finished exterior.

Wind the tank coil onto a suitable form such as the shank of a drill bit, after wrapping the bit with waxed paper. Coat the coil with epoxy cement and allow it to harden overnight. If carefully slid off, the coil will remain in one rigid unit. The coil protector may be a plastic pill box, dime coin holder, or the container in which semiconductors are shipped. This item is epoxied in a hole cut in the nose section of the dipper case and allowed to harden.

The dial (Radio Shack 274-391) may be calibrated using a receiver. Decal labels may be applied. Page numbers punched from a magazine were used in my dipper.

All small components are soldered to three 5-lug terminal strips which are located inside the case sides. Wiring requires two precautions: Locate the FET as near the tank terminals as possible and wire the rf chokes with the shortest leads possible to the FET. This care will minimize minor unwanted dips.

Additional Features

Three I/O ports are provided at the front panel. From left to right, these are labeled RF, AF, and PWR. The rf phono jack output may be used to drive a frequency counter, a mixer, or other equipment.

Conversely, an antenna may be fed in at this point or a sawtooth waveform may be applied to provide a wide-range, swept test signal from the dipper.

The af port may be used to monitor AM signals or to detect ripple on carriers.

The power jack permits the use of an external power source. Isolation diodes prevent conflict between battery and the ac power source and also protect against damage from accidentally applying incorrect polarities. Any of these features may be omitted if only a basic dip meter is desired.

Operation

With power on, set the dial to the highest frequency and adjust the meter indication to about 3/4 of full scale using the potentiometer. No further adjustment of the meter level will be required. It is normal for the meter indication to decrease as the frequency is decreased (due to the low value of the gate-coupling capacitor). This drop is of no consequence because generous dips are available across the full frequency range. Small meter fluctuations across the range also are not of significance.

Granted, tuning is sharp in the high-frequency portion of the coverage. But the chief usefulness of a dip meter is not in precise frequency measurement but in the rapid scanning of a wide range of frequencies.

Now it is a pleasure to quickly scan the 3.9-to-21-MHz range in one uninterrupted swing without all those loose coils, meter adjustments, and recoupling! ■

Reference

1. G. Brizendine W4ATE, "Wide-Range Field-Strength Meter," *Radio & TV News*, November, 1958.

Parts List

C1	Tuning capacitor, 365 pF, Poly Paks No. 7060	$1.00
C2	47-pF dipped mica, Jameco No. DM15-470J	.35
C3	.01-uF disc ceramic, Jameco No. DC.01/50	.08
C4,5	560-pF dipped mica, Jameco No. DM15-561J	1.24
C6	.1-uF disc ceramic, Jameco No. DC.1/12	.12
D1,2,3	1N103 or 1N56	.30
M1	200-uA meter, Poly Paks No. 7021	1.00
L1	41 turns #16 enameled on 7/16-inch form	1.00
Q1	MPF-102 FET, Digi-Key	.54
R1	10k, 1/2-Watt resistor, Jameco	.05
R2	5-megohm pot, Allen-Bradley Type "W" Mini, Napco No. POT-34	.69
RFC1	500 uH, Miller No. 4649	2.10
RFC2	56 uH, Miller No. 4629	1.32
SW1	SPDT subminiature switch, Jameco No. MSL34	.25
Miscellaneous:		
Case	Bud "Econobox" Type CU-124	3.50
Dial	Radio Shack Stock No. 274-391	.69
	Total Cost	$14.23